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Sequence Stratigraphy in a Black Shale Succession: Recognition of Rising and Falling Sea Level in the Chattanooga Shale

For decades, the Late Devonian Chattanooga Shale was thought of as a more or less continuous starved basin succession, deposited far from shore in comparatively deep water. Recognition of evidence for wave reworking and laterally persistent erosion surfaces led to a reappraisal of the succession from a sequence stratigraphic perspective. Although subtle, erosion surfaces may be marked by sandy lags, bone beds, pyritic lags, and exceptionally sharp contacts between black shale packages. Erosion due to sea level drop is indicated by increasing depth of erosion towards the Cincinnati Arch and wave produced features in lag deposits. Chamosite ooids (pyritized during diagenesis) formed on erosion surfaces and indicate deposition above fair weather wave base (probably only a few meters deep). Ooid beds are found 30 to 40 km off the crest of the now eroded Cincinnati Arch, suggesting that portions of the Arch were exposed during low stands of sea level. Black shale packages that drape across erosion surfaces record sea level rise, and exceptionally large concentrations of algal cysts (Tasmanites) may indicate high stands of sea level (MFS). Abundant silica and pyrite filled algal cysts also coincide with high stand conditions. The absence of storm deposits in the upper portions of shale packages suggests water depth in excess of storm wave base, potentially 50 meters or more. Careful study of sedimentary features related to sea level variations allows definition of sequences and parasequences. Conodont data suggest that recognized sequences record fluctuations on a million year scale and likely correlate with global sea level variations. Parasequences record fluctuations on a 100,000 year scale. Although presently the underlying causes are poorly understood, they could represent climatic fluctuations.